

clear from the radioactive determinations that have been made. Inconclusive evidence suggests, however, that the interval between the end of the Huronian and the time of the first fossiliferous Cambrian deposits may well have been as long as the whole of Paleozoic time. This would provide ample time for great thicknesses of sediments older than

those containing recognizable Cambrian fossils to accumulate beyond the edges of the Canadian Shield in the primitive Appalachian and Cordilleran geosynclines. Whether we should call these deposits Cambrian and/or Paleozoic, or whether we should begin the Cambrian and/or the Paleozoic higher up, I will leave to the reader.

PALEONTOLOGY.—*A Cretaceous horseshoe crab from Colorado.*¹ J. B. REESIDE, JR., U. S. Geological Survey, and D. V. HARRIS, Colorado Agricultural and Mechanical College.

The living horseshoe crabs are known along the eastern coast of North America from Maine to Honduras and in the coastal waters of southeastern Asia. Many organisms, both terrestrial and aquatic, follow a similar pattern of discontinuous distribution; such a pattern is commonly associated with a long geologic history and a former wide and continuous distribution over the Northern Hemisphere. Though horseshoe crabs are not now living on the coast of Europe, fossil species have been described, mostly under the generic name *Limulus*, from the Triassic, Jurassic, Cretaceous, and middle Tertiary deposits of that continent. The American species, usually called *Limulus polyphemus* (Linnaeus), is one of the most common of the littoral marine invertebrates, so abundant at places that it has been gathered for use as fertilizer. It is surprising, therefore, considering the history of the order and the present abundance of the American horseshoe crab, to find not a single indisputable record of the order from American Mesozoic and Cenozoic deposits. The only suggestion of such an occurrence known to the writers is that of Wheatley (1861), who wrote of a specimen from the Triassic Newark group at Phoenixville, Pa., "*Limulus?* Fragment of shield probably *Limulus*, black bituminous shales," but the record seems very dubious. Paleozoic members of the order, such as *Euproops* and *Paleolimulus* (Clarke, 1913; Shimer and Shrock, 1944), are well known from American formations, but, so far as the writers know, the single specimen here described is the first unquestionable Mesozoic horseshoe crab from this continent.

Occurrence.—The specimen, a nearly complete internal impression of an abdominal carapace preserved in a very hard calcareous concretion, was found by Mr. Harris on Fossil Ridge, in the Loveland quadrangle, in the SW $\frac{1}{4}$ sec. 11, T. 6 N., R. 69 W., about 5 miles south of Fort Collins, Larimer County, Colo. The horizon of the specimen is 60 feet above the base of the sandstone member of the Pierre shale that makes Fossil Ridge. There is some difference of opinion as to the name to be applied to the sandstone unit. Five named sandstone members are recognized in the Pierre shale of northeastern Colorado (Ball, 1924; Griffiths, 1949), in upward order, the Hygiene, Terry, Rocky Ridge, Larimer, and Richards members. Some of the earlier workers thought that the Fossil Ridge locality belonged to the Larimer member (Mather et al., 1928), but later opinion assigns it chiefly to the Rocky Ridge member (Griffiths, 1949). Its position is about 5,000 feet stratigraphically below the top of the Pierre shale and about 2,000 feet stratigraphically above the base; these figures are somewhat uncertain because of the difficult conditions of measurement.

Associated fossils.—Fossil collecting at Fossil Ridge dates back to the earliest days of geologic investigation in the region, and the fauna recorded there is abundant and varied. Henderson (1908, 1920) listed about 50 species, mostly mollusks, and Griffiths (1949) has essentially repeated his list. Fossil wood in carbonized form is common, but repeated search has disclosed only the single specimen of horseshoe crab. It is notable that the locality yields species that are not known elsewhere in the Western Interior

¹ Publication authorized by the Director, U. S. Geological Survey.

but are found in the Cretaceous of the Gulf Coastal Plain or are represented there by closely related species, for example, *Ostrea fa'cata* Morton, *Erogyra costata* Say, *Capulus spangleri* Henderson, and *Anchura haydeni* White. It is also notable that it is the type locality of a number of species, including *Serpula markmani* Henderson, *Heteropora dimissa* (White), *Pinna lakesi* White, *Inoceramus oblongus* Meek, *Anomia raetiformis* Meek, *Laternula doddsi* (Henderson), *Panope berthoudi* White, *Capulus spangleri* Henderson, *Anchura haydeni* White, and *Volutoderma? clatworthyi* Henderson. The species of *Inoceramus*, *Baculites*, and *Acanthoscaphites* serve best to tie the occurrence to other localities in the Western Interior. The horizons in Fossil Ridge are equivalent faunally to the Verendrye and the Virgin Creek members of the typical Pierre shale and most probably to the upper Campanian of the European classification.

Taxonomy.—Van der Hoeven (1838) and Pocock (1902), among others, have discussed the living horseshoe crabs, and the following statement has been taken chiefly from their work. Linnaeus in 1758 placed under *Monoculus polyphemus* horseshoe crabs from America and from eastern Asia, but in 1764 he definitely used the name with a description of the American form. Gronovius in 1764 proposed to use *Xiphosura* for Linnaeus's species, citing it by reference and number, though not by name, and Brünnich in 1771, Scopoli in 1777, and Meuschen in 1778 adopted *Xiphosura* for the genus. Müller in 1785 ignored Gronovius' name and proposed *Limulus* for the species *gigas*, including under that name both American and Asiatic forms. Fabricius in 1793 restricted *Limulus* to the genus typified by the species *gigas*, for which he used, however, the name *polyphemus*, and proposed the name *cyclops* for another form, probably including the American species. Lamarck in 1801 proposed *Polyphemus* as a generic name for Linnaeus' species, separating the Asiatic species as *gigas* and naming the American species *occidentalis*. Latreille in 1802 proposed to use *Xiphosura* as the name for the order containing the horseshoe crabs, retained *Limulus* for the generic name, and distinguished under it four species, restricting the name *polyphemus* to the American form. Leach in 1814 proposed the name *Limulus sowerbii* for the American species, assuming the name *poly-*

phemus to be invalid for it. In 1819 he introduced the generic name *Tachypleus* for one of the Asiatic species, reserving *Limulus* for six other species, including *sowerbii* and an *americanus*. Van der Hoeven in 1838 admitted four species, one American and three Asiatic, under the single generic name *Limulus*. There seem to have been few departures from this practice for six decades. Pocock, however, in 1902 adopted *Xiphosura* Gronovius as the generic name for the American species *polyphemus* Linnaeus; *Tachypleus* Leach for three Asiatic species, *gigas* Müller, *tridentatus* Leach, and a new species *hoeveni*; and proposed the genus *Carcinoscorpius* for the species *rotundicauda* Lamarck. Under these names he placed all the previously named living species. Pocock used the name *Xiphosurae* for the order and proposed the family *Xiphosuridae*, with the subfamily *Xiphosurinae* for *Xiphosura* and the subfamily *Tachypleinae* for *Tachypleus* and *Carcinoscorpius*. Pocock placed "Limulinae" in parentheses after "Xiphosurinae" and was the author of both terms. In 1925 the International Commission on Zoological Nomenclature in Opinion 89 (Stiles, pp. 27-33) rejected Gronovius (1764) as a source of systematic names, and in 1928 in Opinion 104 (Stiles, pp. 25-28) it placed the name *Limulus* on the Official List of genera, with "*polyphemus* Linn., 1758a" (sic), as the type species. In decisions announced in June 1950 the Commission formally declared the work of Meuschen (1778) unavailable (Hemming, p. 502) and the generic names of Brünnich (1771) available for nomenclature (Hemming, pp. 307-315). This would have the effect of reinstating *Xiphosura* as of Brünnich as the authorized generic name for the American horseshoe crab, but the Commission directed the Secretary to prepare a report, with recommendations, as to "whether the name *Limulus* Müller, 1785, erroneously placed on the 'Official List of Generic Names in Zoology' by Opinion 104 should be validated . . . or removed from the 'Official List.'" No evaluation has been made of Scopoli's use in 1777 of *Xiphosura*, and at this date (January 1952) the matter is still under discussion. Most zoologists before and since Pocock's contribution have used *Limulidae* for the family and *Limulus* for the American species (e.g., Parker and Haswell, 1949), and paleontologists have used *Limulus* almost exclusively for the Meso-

zoic and Tertiary species (e.g., Zittel, 1885; Clarke, 1913; Shimer and Shrock, 1944). The writers have somewhat reluctantly used *Limulus* rather than *Xiphosura*.

Most of the features necessary for generic assignment—the character of the appendages of the cephalothorax (prosoma) and of the abdomen (opisthosoma), the form of the movable spines along the side of the abdomen, the form of the cross section of the telson—are missing in the fossil specimen here described. The proportions of the abdomen may be observed, however, and are believed to permit distinction between the subfamilies recognized by Pocock.

Pocock (1902, p. 260) cites for his subfamily Xiphosurinae (= Limulinae) the following characters of the abdomen (opisthosoma):

Opisthosoma more vaulted, not so markedly hexagonal, owing to lesser prominence of the lateral angle, which lies well in advance of the middle of the lateral border, making the spiniferous edge much longer than the part of the border that has no movable spines; the latter abruptly bent downwards in the posterior two thirds of its length, the spike that it bears lying in front of its middle and much nearer to the 'waist' than to the spike preceding the first movable spine; posterior prolongation of opisthosoma more prominent, the inner edge straight and cutting the outer at an acute angle. . . .

Lateral movable spines of opisthosoma alike in both sexes, becoming progressively shorter from before backwards, and gradually tapering from base to apex.

Pocock distinguishes for his subfamily Tachypleinae the following characters of the abdomen (opisthosoma):

Opisthosoma less vaulted, more markedly hexagonal owing to the greater prominence of the lateral angle which lies near the middle of the lateral border, making its spiniferous and non-spiniferous parts subequal; the latter not so abruptly bent downwards posteriorly, the area behind its spike, which lies, if anything, farther from the waist than from the lateral angle, subparallel to the area in front of it; posterior prolongations of opisthosoma less prominent, their inner edge convex and cutting the outer at a right angle in the adult. . . .

Lateral movable spines on opisthosoma in female short, abruptly narrowed and pointed at apex, not evenly tapering to a point.

It appears to the writers that the present specimen agrees much more with the characters of the Limulinae than with those of the Tachypleinae, and that no characters present would

separate it from *Limulus*, the sole member of the subfamily Limulinae. It is therefore referred to that genus and for convenience of reference is given a specific name.

Order XIPHOSURA Latreille

Family LIMULIDAE Zittel

Subfamily LIMULINAE Pocock

Genus *Limulus* Müller

Limulus coffini Reeside and Harris, n. sp.

Figs. 1-3

This species is represented by the internal impression of the abdominal carapace. No trace of the movable lateral spines or of the telson remains. It is 83 mm long over-all, 88 mm wide, and 30 mm high. The outline is an inverted triangle with the apex truncated and in no way suggests the hexagonal outline of the abdomen of the Tachypleinae. It is relatively high (vaulted), with a sharp median longitudinal ridge. The ridge is 60 mm long, and a blunt spine is indicated at the front end and another 32 mm behind it; there may have been a third at the posterior end, but, if so, it is not clearly shown. Anteriorly in a sharp depression on each side of the median ridge and trending toward the ridge from front to back, is a line of six pits, representing inward projections of the carapace, that mark off the six segments included in the mesosomal part of the abdomen. The anterior part of the flanks of the abdominal carapace are evenly rounded; the posterior part is nearly flat and bears a strong muscle scar, presumably for attachment of the muscles of the telson. Each of the posterior lateral margins bears six subequal indentations that mark the sites of the movable spines. The anterior lateral margins are much shorter than the posterior lateral margins, and on the left side the impression suggests that they were bent down. The posterior prolongations are prominent, with the inner edge straight and meeting the outer edge in an acute angle.

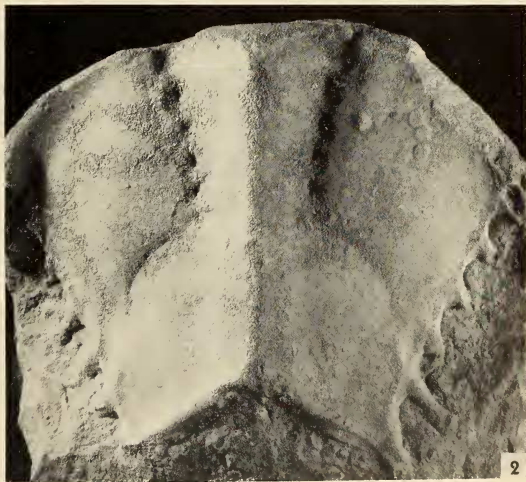
The general character of the abdominal carapace indicated by the specimen is much like that of *L. polyphemus* (Linnaeus). It would seem to differ in the more slender spikes separating the indentations of the posterior lateral margins and in the somewhat shorter posterior prolongations.

The specific name is for Prof. R. G. Coffin, Colorado Agricultural and Mechanical College,

Fort Collins, Colo., an assiduous student of the geology of northeastern Colorado. The type specimen is deposited in the U. S. National Museum.

REFERENCES

- BALL, M. W. *Gas near Fort Collins, Colorado*. Bull. Amer. Assoc. Petrol. Geol. **8**(1): 84. 1924.
- CLARKE, J. M. *Arachnida*. In Zittel-Eastman's "Text-book of Paleontology." London, 1913.
- BEEBE, C. W. *King crab*. The New International Encyclopaedia, ed. 2, **13**: 244-245. 1918.
- BRÜNNICH, Z. T. *Zoologiae fundamenta praelectionibus academicis accommodata*. Copenhagen and Leipzig, 1771.
- FABRICIUS, J. C. *Entomologia systematica emendata et aucta* **2**: 487-488. Copenhagen, 1793.
- GRIFFITTS, M. O. *Zones of Pierre formation of Colorado*. Bull. Amer. Assoc. Petrol. Geol. **33**(12): 2011-2028. 1949.



FIGS. 1-3.—*Limulus coffini* Reeside and Harris, n. sp., side, dorsal, and rear views. $\times 1$.

- GRONOVIVS, L. F. *Zoophylacium Gronovianum*, etc., fasc. 2, Insecta: 220. Leyden, 1764.
- HEMMING, FRANCIS. *The official record of proceedings of the International Commission on Zoological Nomenclature at its session held in Paris in July 1948*. Bull. Zool. Nomencl. 4, June 9, 1950.
Conclusions of twelfth meeting, pp. 307-315.
Conclusions of fourteenth meeting, p. 502.
- HENDERSON, JUNIUS. *The sandstone of Fossil Ridge in northern Colorado and its fauna*. Colorado Univ. Stud. 5: 179-192. 1908.
- . *The Cretaceous formations of northeastern Colorado*. Colorado Geol. Survey Bull. 19: 31-32. 1920.
- LAMARCK, J. B. *Système des animaux sans vertèbres*, etc. 1: 168. Paris, 1801.
- LATREILLE, P. A. *Histoire naturelle générale et particulière des crustacés et des insectes*, etc. Paris, 1802.
- LEACH, W. E. *The zoological miscellany*, etc.: 84. London, 1814.
- . *Dictionnaire des sciences naturelles* 14: 537-538. Paris, 1819.
- LINNAEUS, CAROLUS. *Systema naturae*, ed. 10: 634. Stockholm, 1758.
- . *Museum S. R. M. Ludovicae Ulrica Reginae*, etc.: 460. Stockholm, 1764.
- LOCHHEAD, J. H., in F. A. BROWN, JR., ed. *Selected invertebrate types*: 31. New York, 1950.
- MATHER, K. F., GILLULY, JAMES, AND LUSK, R. G. *Geology and oil and gas prospects of northeastern Colorado*. U. S. Geol. Surv. Bull. 796-B: 89. 1928.
- MEUSCHEN, F. C. *Museum Gronovianum*, etc.: 83. Leyden, 1778.
- MÜLLER, O. F. *Entomostraca seu insecta testacea*, etc.: 124-126. Leipzig and Copenhagen, 1785.
- PARKER, T. J., AND HASWELL, W. A. *A text-book of zoology*, ed. 6, 1: 514. London, 1949.
- POCOCK, R. I. *The taxonomy of Recent species of Limulus*. Ann. Mag. Nat. Hist., ser. 7, 9(42): 256-266. 1902.
- SCOPOLI, J. A. *Introductio ad historiam naturalem*: 405. Prague, 1777.
- SHIMER, H. W., AND SHROCK, R. R. *Index fossils of North America*: 705-707. New York, 1944.
- STILES, C. W. *Opinions rendered by the International Commission on Zoological Nomenclature*. Smithsonian Misc. Coll. 73.
Opinions 82 to 90, no. 3 (Publ. 2830). Dec. 16, 1925.
Opinions 98 to 104, no. 5 (Publ. 2973). Sept. 19, 1928.
- VAN DER HOEVEN, JAN. *Recherches sur l'histoire naturelle et l'anatomie des limules*. Leyden, 1838.
- WHEATLEY, C. M. *Remarks on the Mesozoic red sandstone of the Atlantic slope and notice of the discovery of a bone bed therein at Phoenixville, Pa.* Amer. Journ. Sci., ser. 2, 32: 43. 1861.
- ZITTEL, K. A. *Handbuch der Palaeontologie*. Abt. 1: Palaeozoologie. 2: 643-645. 1885.

BOTANY.—*New mosses from southern Brazil*. EDWIN B. BARTRAM, Bushkill, Pa.

At intervals during the past 15 years I have been receiving carefully selected and beautifully prepared specimens of mosses from Señor Aloysio Sehnem, Colegio S. Inacio, São Salvador, collected in various parts of the Brazilian states of Santa Catarina and Rio Grande do Sul. These have been nicely supplemented by less extensive collection made by Señor P. Raulino Reitz, Herbario Barbosa Rodrigues, Itajai, from the same general area. The total number of species represented is well over 250 distributed in about 120 genera. Preparatory to publishing a complete list of the collections from this interesting temperate region, it seems advisable to describe the following 18 new species that appear in the series. The types of the new species are in the author's herbarium.

FISSIDENTACEAE

Fissidens (Heterocaulon) sehnemii Bartr.,
 sp. nov.

Dioicus; pusillus, dense caespitosus, viridibus.

Caulis erectus, simplex, fertilis brevissimus, sterilis usque ad 3 mm altus; folia plantae sterilis ad 14 juga, late patentia, infima minuta, superiora sensim majora, late ovata, acuta, usque ad 0.4 mm longa/et 0.15 mm lata, integra, lamina vera tantum limbata, prope apicem folii producta, lamina dorsalis longe ultra basin folii enata, basi attenuata; costa infra apicem folii evanida; cellulae ovali-hexagonae, laevissimae, diam. circa 10 μ . Folia plantae fertilis circa 3 juga, comalia multo majora, e basi ovata longe acuminata; seta 3-3.5 mm longa, rubra; theca erecta, oblongo-cylindrica; operculum oblique conico-rostratum; dentes peristomii ad 200 μ longi, filiformiter acuminati, superne irregulariter fissi.

Rio Grande do Sul: Estação São Salvador, in terram, alt. 600 m, A. Sehnem no. 2041.

Near *F. antennidens* C. M. as far as one can judge from the description but distinct in the leaf structure, which shows the vaginant lamina produced nearly to the apex of the leaf and indistinctly bordered only in the comal leaves.